ANIMAL BEHAVIOR (ANBE)

Faculty

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The program in animal behavior offers an interdisciplinary major that includes subject matter in biology, chemistry, mathematics, physics and psychology. The focus is directed toward understanding behavior and providing the student with a background uniting ecological, ethological, environmental, evolutionary, experimental and physiological approaches to the study of animal life.

During the 50 years that Bucknell University has offered this major, animal behavior has been chosen by students seeking a broad background in the natural and social sciences; by those who become researchers; as a background for medical or veterinary science; and, because of the breadth of requirements, by persons filling a variety of positions in commerce, law and public service.

The major may be pursued under either the bachelor of arts or the bachelor of science programs. The programs differ chiefly in the number of advanced science courses and laboratories. All students are encouraged to seek laboratory and field experiences in addition to required coursework. The Bucknell laboratories, as well as opportunities abroad, are well suited to complement the student's education. Research culminating in an honors thesis is especially recommended.

Animal behavior majors will fulfill the Culminating Experience requirement by taking ANBE 320 Advanced Topics in Animal Behavior in their senior year. The course is open only to senior animal behavior majors and is designed to explore diverse areas and concepts in animal behavior particularly relevant to a student graduating with a degree in animal behavior. The course encourages majors to reflect on what they learned over the years and to look to the future for emerging ideas within the field.

Information literacy, formal presentation and writing goals within the major will be fulfilled when students take ANBE 296 Advanced Methods in Animal Behavior/PSYC 296 Advanced Methods in Animal Behavior and ANBE 320 Advanced Topics in Animal Behavior. In ANBE 296 Advanced Methods in Animal Behavior/PSYC 296 Advanced Methods in Animal Behavior, students conduct experimental research, present their work to the class in a conference-style session, and write their research as a journal-style publication. In so doing, they search the literature to find sources that provide a theoretical basis for their study, develop the hypotheses tested, and instruct the design of their study. In ANBE 320 Advanced Topics in Animal Behavior, students will develop more theoretical and conceptual writing skills by conducting literature searches on topics in animal behavior and synthesizing the material into a review-style paper. Students will present the results of their literature reviews to the class and lead class discussions on selected topics, also enhancing their presentation skills. Although information literacy, formal presentation, and writing goals within the major will be specifically addressed in ANBE 296 Advanced Methods in Animal Behavior/PSYC 296 Advanced Methods in Animal Behavior and ANBE 320 Advanced Topics in Animal Behavior, majors will receive similar training in these skills in many other courses they take as electives and requirements within the major.

Bachelor of Arts

The **Bachelor of Arts major** consists of the following 11 required courses.

Animal Behavior core course		
ANBE/BIOL/PSYC 266	Animal Behavior	1
Applied Research Methods in Animal Behavior		
ANBE/PSYC 296	Advanced Methods in Animal Behavior	1
Biology core courses		
BIOL 201	Biological Inquiries and Observations	1
or BIOL 202	Course-based Undergraduate Research Experience	
BIOL 203	Integrated Concepts in Biology Fall	1
BIOL 204	Integrated Concepts in Biology Spring	1
Psychology core requirements		
PSYC 203	Learning	1
PSYC 250	Biopsychology	1
Statistics requirement		
PSYC 215	Psychological Statistics	1
or MATH 216	Statistics I	
Upper-level animal behavior electives [1]		
Select two of the following:		2
ANBE/BIOL 305	Vertebrate Ecology	

ANBE/BIOL 307	Conservation Genetics	
ANBE/BIOL 309	Wildlife and Emerging Diseases	
ANBE/BIOL 312	Comparative Vertebrate Anatomy	
ANBE/BIOL 313	Mammalogy	
ANBE/BIOL 314	Amphibian Biology and Conservation	
ANBE/BIOL 318	Principles of Physiology	
ANBE 319	Topics in Animal Behavior	
ANBE/BIOL 321	Behavioral Ecology	
ANBE/BIOL 325	Evolutionary Genomics	
ANBE/BIOL 328	Endocrinology	
ANBE/BIOL 341	Evolution	
ANBE/BIOL 342	Neuroethology	
ANBE/BIOL 353	Ecosystem Ecology	
ANBE/BIOL 354	Tropical Ecology	
ANBE/BIOL 355	Social Insects	
ANBE/BIOL 357	Ornithology	
ANBE/BIOL 358	Invertebrate Zoology	
ANBE/BIOL 359	General Entomology	
ANBE/BIOL/PSYC 370	Primate Behavior and Ecology	
ANBE/PSYC 371	Primate Minds	
ANBE/PSYC 372	Comparative Cognition	
ANBE/BIOL 382	Mass Extinctions	
BIOL 324	Neurophysiology	
BIOL 329	Foundations of Genetics	
PSYC 324	Advanced Psychological Statistics	
Culminating Experience requirement		
ANBE 320	Advanced Topics in Animal Behavior	1

[1] Cross-listed courses are indicated. With special permission, other upper-level PSYC/BIOL courses may be considered as electives.

Bachelor of Science

The **Bachelor of Science major** consists of the following 17 required courses:

Animal Behavior core course		
ANBE/BIOL/PSYC 266	Animal Behavior	1
Applied Research Methods in Animal Behavior		
ANBE/PSYC 296	Advanced Methods in Animal Behavior	1
PSYC 290	Advanced Methods in Biopsychology	1
or PSYC 293	Advanced Methods in Learning	
Quantitative requirements [1]		
Select two of the following:		2
BIOL 364	Advanced Data Analysis in Biology	
CSCI 203	Introduction to Computer Science	
CSCI 204	Data Structures & Algorithms	
GEOG 204	Applied G.I.S.	
MATH 201	Calculus I	
MATH 202	Calculus II	
MATH 211	Calculus III	
MATH 217	Statistics II	
MATH 219	Topics in Applied Mathematics	
MATH 260	Applications to Medicine and Biology	
PHYS 211	Classical and Modern Physics I	

PHYS 212	Classical and Modern Physics II	
PSYC 324	Advanced Psychological Statistics	
Biology core courses		
BIOL 201	Biological Inquiries and Observations	1
BIOL 202	Course-based Undergraduate Research Experience	1
BIOL 203	Integrated Concepts in Biology Fall	1
BIOL 204	Integrated Concepts in Biology Spring	1
Psychology core requirements		
PSYC 203	Learning	1
PSYC 250	Biopsychology	1
Statistics requirement		
MATH 216	Statistics I	1
or PSYC 215	Psychological Statistics	
Chemistry requirement		
CHEM 205	Principles of Chemistry	1
Upper-level animal behavior electives [2]		
Select three of the following:		3
ANBE/BIOL 305	Vertebrate Ecology	
ANBE/BIOL 307	Conservation Genetics	
ANBE/BIOL 309	Wildlife and Emerging Diseases	
ANBE/BIOL 312	Comparative Vertebrate Anatomy	
ANBE/BIOL 313	Mammalogy	
ANBE/BIOL 314	Amphibian Biology and Conservation	
ANBE/BIOL 318	Principles of Physiology	
ANBE 319	Topics in Animal Behavior	
ANBE/BIOL 321	Behavioral Ecology	
ANBE/BIOL 325	Evolutionary Genomics	
ANBE/BIOL 328	Endocrinology	
ANBE/BIOL 341	Evolution	
ANBE/BIOL 342	Neuroethology	
ANBE/BIOL 353	Ecosystem Ecology	
ANBE/BIOL 354	Tropical Ecology	
ANBE/BIOL 355	Social Insects	
ANBE/BIOL 357	Ornithology	
ANBE/BIOL 358	Invertebrate Zoology	
ANBE/BIOL 359	General Entomology	
ANBE/BIOL/PSYC 370	Primate Behavior and Ecology	
ANBE/PSYC 371	Primate Minds	
ANBE/PSYC 372	Comparative Cognition	
ANBE/BIOL 382	Mass Extinctions	
BIOL 324	Neurophysiology	
BIOL 329	Foundations of Genetics	
PSYC 324	Advanced Psychological Statistics [3]	
Culminating Experience requirement		
ANBE 320	Advanced Topics in Animal Behavior	1
Total Credits		**17**

1 Other quantitative-based courses may be approved with special permission.

2 Cross-listed courses are indicated. With special permission, other upper-level PSYC/BIOL courses may be considered as electives.

3 PSYC 324 may not be counted as a 300-level elective if it is used to satisfy the quantitative requirement.

The recommended sequence for the Bachelor of Science major is as follows:

First Year

First Semester	Credits	Second Semester	Credits
ANBE 266	1	BIOL 201 or 202	1
BIOL 201 or 202	1	PSYC 215 or MATH 216	1
	2		**2**

Sophomore

First Semester	Credits	Second Semester	Credits
BIOL 203	1	BIOL 204	1
CHEM 205	1	PSYC 203 or 250	1
PSYC 250 or 296	1		
	3		**2**

Junior

First Semester	Credits	Second Semester	Credits
Animal behavior elective	1	Animal behavior elective	1
PSYC 203 or 250	1	PSYC 290 or 293	1
	2		**2**

Senior

First Semester	Credits	Second Semester	Credits
ANBE 320	1	Animal behavior elective	1
Quantitative elective	1	Quantitative elective	1
	2		**2**

Total Credits: 17

Students are advised to take the first two biology core courses in any order during their first year (BIOL 201 Biological Inquiries and Observations and BIOL 202 Course-based Undergraduate Research Experience). Students are advised to take BIOL 203 Integrated Concepts in Biology Fall and BIOL 204 Integrated Concepts in Biology Spring in sequence during their second year. BIOL 203 and BIOL 204 serve as prerequisites for most of the 300-level elective courses. Note that one semester of independent research (ANBE 391 Research) or honors credit (ANBE 399 Senior Thesis) may count toward the upper-level electives for the BA or BS.

Off-campus study and research are encouraged. Recent students have studied in Africa, Australia, New Zealand and Ecuador. Other programs in Europe, Asia, South and Central America are also appropriate. Students are advised to explore opportunities through The Office of Global and Off-campus Education (OGOE) and to coordinate off-campus coursework in consultation with a faculty adviser. Many minors complement studies in animal behavior and students are encouraged to explore options within the humanities and social sciences in consultation with a faculty adviser.

Majors in Animal Behavior will:

1. Understand evolutionary theory as a unifying construct that brings together teachings of many diverse disciplines.
2. Understand the proximate and ultimate bases for behavior (how and why animals behave as they do).
3. Understand the process through which scientific information is derived, evaluated and communicated.

Courses

ANBE 266. Animal Behavior. 1 Credit.
Offered Both Fall and Spring; Lecture hours:3
A survey of important theories, issues, and empirical techniques in the interdisciplinary field of animal behavior emphasizing both proximate and ultimate mechanisms and explanations for behavior. Crosslisted as BIOL 266 and PSYC 266.

ANBE 291. Directed Study in Animal Behavior. .5-1 Credits.
Offered Either Fall or Spring; Lecture hours:Varies,Other:Varies; Repeatable
An entry into animal behavior research or other independent study directed by a faculty member. Experiences might include library work, collecting data, hands on experiences, entering and analyzing data, and other activities associated with engagement in research, animal management, and faculty-directed inquiry. Prerequisite: Instructor permission.

ANBE 296. Advanced Methods in Animal Behavior. 1 Credit.
Offered Either Fall or Spring; Lecture hours:Varies,Other:3; May require dissection or live animal experimentation
Laboratory and/or field research to accompany ANBE 266, BIOL 266, or PSYC 266. Prerequisites: (MATH 216 or PSYC 215) and (BIOL 201 or BIOL 202 or BIOL 203 or BIOL 204 or BIOL 205 or PSYC 216) and prerequisite or corequisite (ANBE 266 or BIOL 266 or PSYC 266). Crosslisted as PSYC 296.

ANBE 2NT. Animal Behavior Non-traditional Study. .5-4 Credits.
Offered Fall, Spring, Summer; Lecture hours:Varies; Repeatable
Non-traditional course in Animal Behavior. Prerequisite: permission of the instructor.

ANBE 305. Vertebrate Ecology. 1 Credit.
Offered Occasionally; Lecture hours:3,Other:3
An upper-level laboratory course covering topics in Vertebrate Animal Ecology. Subfields of ecology to be determined by the instructor. Crosslisted as ANBE 605, BIOL 305 and BIOL 605.

ANBE 307. Conservation Genetics. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3,Other:3
As biodiversity has quickly eroded for the past few centuries, some scientists argue that humans are causing the 6th mass extinction event. This course emphasizes the application of population genetics, molecular phylogenetics, and reproductive genetics to answering biological questions in wildlife conservation. Crosslisted as ANBE 607 and BIOL 307 and BIOL 607.

ANBE 309. Wildlife and Emerging Diseases. 1 Credit.
Offered Alternating Fall Semester; Lecture hours:3
Biology of wildlife diseases, especially zoonoses (infections that jump to humans). Course will integrate popular and scientific sources. Prerequisites: (BIOL 203 and BIOL 204) or BIOL 206 and permission of the instructor. Crosslisted as ANBE 609, BIOL 309 and BIOL 609.

ANBE 311. Climate Change Ecology. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3,Other:3
Climate change is one of the most important and complex challenges that we are facing in the 21st century. To overcome we must find solutions that stop destructive practices, mitigate harm and use adaptive approaches. Topics included: causes and consequences; resilience; biodiversity; conservation; social and economic issues; amplifying diverse voices. Crosslisted as ANBE 611, BIOL 311 and BIOL 611.

ANBE 312. Comparative Vertebrate Anatomy. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3,Other:3
Gross morphology with emphasis on functional and evolutionary modifications of animal structure. Gross dissection and techniques used in morphology. Prerequisites: BIOL 122 or (BIOL 203 and BIOL 204) or BIOL 206 and permission of the instructor. Crosslisted as ANBE 612, BIOL 312 and BIOL 612.

ANBE 313. Mammalogy. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3,Other:3
Biology of mammals, including evolution, classification, biodiversity, behavior, anatomy, physiology, ecology and conservation. Lab will include specimen identification, preparation and field studies. Prerequisites: (BIOL 203 and BIOL 204) or BIOL 206 and permission of the instructor. Crosslisted as ANBE 613, BIOL 313 and BIOL 613.

ANBE 314. Amphibian Biology and Conservation. 1 Credit.
Offered Fall Semester Only; Lecture hours:3,Other:3
The biology of amphibians, including classification, physiology, reproduction, ecology, evolution, and conservation. Laboratory section will include identification of amphibians and field work to identify conservation issues surrounding local amphibian populations. Prerequisites: (BIOL 203 and BIOL 204) or (BIOL 206 and BIOL 208) and permission of the instructor. Crosslisted as BIOL 314 and BIOL 614 and ANBE 614.

ANBE 318. Principles of Physiology. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3
Emphasizes the breadth of physiology and explores physiological principles of animals from a cellular, organismal, medical and ecological framework. Laboratory focuses on experimental design and independent research. Prerequisites: (BIOL 203 and BIOL 204) or (BIOL 205 and BIOL 206) and permission of the instructor. Crosslisted as ANBE 618, BIOL 318 and BIOL 618.

ANBE 319. Topics in Animal Behavior. .5-1 Credits.
Offered Both Fall and Spring; Lecture hours:3; Repeatable
Occasional seminars on selected topics of current interest in animal behavior. Prerequisites: (BIOL 203 and BIOL 204) or (BIOL 206 or ANBE 266 or BIOL 266 or PSYC 266), junior or senior status and permission of the instructor. Crosslisted as ANBE 619.

ANBE 320. Advanced Topics in Animal Behavior. 1 Credit.
Offered Fall Semester Only; Lecture hours:3
Culminating Experience seminar for senior animal behavior majors covering selected topics of current interest in animal behavior. Prerequisites: open to seniors in animal behavior and 4 or 5-year engineers. Permission of the instructor.

ANBE 321. Behavioral Ecology. 1 Credit.
Offered Fall Semester Only; Lecture hours:3
How have ecological selection pressures (generated by animals' biotic and abiotic environments) shaped the fascinating diversity of animal behaviors? Topics include habitat choice, foraging behavior, defenses against predation, cooperation and competition, sexual selection, and parental care. Heavy emphasis on primary literature and experimental design. Crosslisted as ANBE 621, BIOL 321 and BIOL 621.

ANBE 325. Evolutionary Genomics. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3,Other:3
An exploration of evolutionary questions using large sequencing databases, with an emphasis on developing strategies for computational sequence analysis. Includes review of the primary literature. No coding experience. Prerequisites: (BIOL 203 and BIOL 204) or BIOL 207 and permission of the instructor. BIOL 208 is recommended but not required. Crosslisted as ANBE 625, BIOL 325 and BIOL 625.

ANBE 328. Endocrinology. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3,Problem Session:2
Regulation and function of hormones and their receptors from molecular to organismal levels. Role of hormones in development, physiology, and behavior; endocrine disease. Prerequisites: (BIOL 203 and BIOL 204) or BIOL 205 and permission of the instructor. Crosslisted as ANBE 628, BIOL 328 and BIOL 628.

ANBE 341. Evolution. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3
Survey of evolutionary processes, phenomena, and mechanisms. Topics covered may include natural selection, sexual selection, adaptation, evolutionary constraints, speciation, evolution and development, coevolution, behavioral evolution, and macroevolution. Prerequisites: (BIOL 203 and BIOL 204) or (BIOL 208) and permission of the instructor. Crosslisted as ANBE 641 and BIOL 341 and BIOL 641.

ANBE 342. Neuroethology. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3
A course that integrates neurobiology and behavior in natural contexts. Emphasis on signal detection, recognition, discrimination, localization, orientation, and the control of complex acts. Neuronal and hormonal mechanisms, ontogeny and evolution of behavior will be considered. Crosslisted as ANBE 342 and ANBE 642 and BIOL 642.

ANBE 353. Ecosystem Ecology. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3,Recitation:1
Interactions between organisms and the physical and chemical environment including nutrient cycling and energy flow, biogeochemistry, and temporal and spatial dynamics of ecosystems. Prerequisites: (BIOL 203 and BIOL 204) or BIOL 208 or ENST 208, junior or senior status, and permission of the instructor. Crosslisted as ANBE 653, BIOL 353, BIOL 653, ENST 353.

ANBE 354. Tropical Ecology. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3
Introduction to tropical ecology including life history strategies of vertebrates and invertebrates, biodiversity management and conservation. Emphasis on class and individual projects, data collection and journal keeping. Prerequisites: (BIOL 203 and BIOL 204) or BIOL 208 or permission of the instructor. Crosslisted as ANBE 654 and BIOL 354 and BIOL 654.

ANBE 355. Social Insects. 1 Credit.
Offered Fall Semester Only; Lecture hours:3,Other:3; May require dissection or live animal experimentation
Evolution and genetics of social behavior, caste, communication in foraging and colony defense, queen and worker control over reproduction, social homeostasis, and population dynamics. Occasionally may be taught as a laboratory science. Prerequisites: (BIOL 203 and BIOL 204) or BIOL 208 and permission of the instructor. Crosslisted as BIOL 355.

ANBE 357. Ornithology. 1 Credit.
Offered Occasionally; Lecture hours:3,Other:3
The biology of birds, including evolution, behavior, anatomy, physiology, ecology, and conservation; lab trips focus on identification of birds in the field. Prerequisites: (BIOL 203 and BIOL 204) or (BIOL 206 and BIOL 208) and permission of the instructor. Crosslisted as ANBE 657 and BIOL 357 and BIOL 657.

ANBE 358. Invertebrate Zoology. 1 Credit.
Offered Alternating Fall Semester; Lecture hours:3,Other:3
A survey of the animal phyla covering phylogenetic relationships, functional morphology, ecology, life histories, symbiosis, ontogeny and behavior. Includes hands-on study of organisms in lab and field. Prerequisites: (BIOL 203 and BIOL 204) or (BIOL 206 and BIOL 208) and permission of the instructor. Crosslisted as ANBE 658, BIOL 358 and BIOL 658.

ANBE 359. General Entomology. 1 Credit.
Offered Alternating Fall Semester; Lecture hours:3,Other:3
The biology of insects and their kin: anatomy, physiology, ecology, behavior, development, evolution, systematics and diversity. Prerequisites: (BIOL 203 and BIOL 204) or (BIOL 206 and BIOL 208) and permission of the instructor. Crosslisted as ANBE 659, BIOL 359 and BIOL 659.

ANBE 370. Primate Behavior and Ecology. 1 Credit.
Offered Fall Semester Only; Lecture hours:3; May require dissection or live animal experimentation
Introduction to research on prosimians, monkeys, and apes with emphasis on the evolutionary origin of diversity, habitat use, social structure, social behavior, and cognitive abilities. Crosslisted as ANBE 670 and BIOL 370 and BIOL 670 and PSYC 370 and PSYC 670.

ANBE 371. Primate Minds. 1 Credit.
Offered Alternate Fall or Spring; Lecture hours:3
An investigation into the cognitive abilities and capacities of nonhuman primates emphasizing a comparative perspective. Prerequisites: ANBE 266 or BIOL 266 or PSYC 266 and permission of the instructor. Crosslisted as ANBE 671 and PSYC 371 and PSYC 671.

ANBE 372. Comparative Cognition. 1 Credit.
Offered Both Fall and Spring; Lecture hours:3
Advanced seminar exploring cognition and behavior from evolutionary and comparative perspectives. Topics will include social behavior, memory, communication, spatial cognition, learning, and meta-cognition. Prerequisite: (ANBE 266 or BIOL 266 or PSYC 266) or (PSYC 203 or PSYC 204). Crosslisted as ANBE 672 and PSYC 372 and PSYC 672.

ANBE 380. SciComm: Communicating Science to Non-Scientists. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3
Seminar covering effective strategies for communicating science to a non-scientific audience. We will use an active community-based approach to gain hands-on experience developing, implementing, and disseminating scientific information to the public. This course is open to all upper level natural science majors. Crosslisted as ANBE 681.

ANBE 382. Mass Extinctions. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3
An upper-level course investigates the past five mass extinctions and the on-going sixth mass extinction of organisms from the perspective of ecology, evolution and conservation biology. Prerequisites: (BIOL 203 and BIOL 204) or BIOL 208 and permission of the instructor. Crosslisted as ANBE 682, BIOL 382 and BIOL 682.

ANBE 391. Research. .5-1 Credits.
Offered Fall, Spring, Summer; Lecture hours:Varies,Other:Varies; Repeatable; May require dissection or live animal experimentation
Independent research, with faculty supervision, in the study of animal behavior. Crosslisted as ANBE 691. Prerequisite: permission of the instructor.

ANBE 399. Senior Thesis. 1 Credit.
Offered Fall, Spring, Summer; Lecture hours:2,Other:10; Repeatable; May require dissection or live animal experimentation
Original research leading to a thesis presentation on a topic related to the study of animal behavior. Prerequisite: permission of the instructor.

ANBE 3NT. Animal Behavior Non-traditional Study. 1-2 Credits.
Offered Fall, Spring, Summer; Lecture hours:Varies,Other:Varies
Non-traditional study in Animal Behavior. Prerequisite: permission of the instructor.